Title: Balloons, Balloons, Flying High

Brief Overview:

This thematic learning unit focusing on balloons will allow students to collect, organize, analyze, interpret data in a real-world context. Additionally, students will use concepts of probability to predict event outcomes, comparing theoretical and experimental probability.

Links to NCTM Standards:

- **Mathematics as Problem Solving**
  Students will demonstrate their ability to solve problems in mathematics including problems with open-ended answers and problems which are solved in a cooperative atmosphere.

- **Mathematics as Communication**
  Students will demonstrate their ability to communicate mathematically. They will read, write and discuss mathematics with language and the signs, symbols, and the terms associated with data analysis. Students will use oral and written language to justify their solutions to open-ended questions.

- **Mathematics as Reasoning**
  Students will demonstrate their ability to reason mathematically. They will make conjectures, gather evidence, and build arguments.

- **Mathematical Connections**
  Students will demonstrate their ability to connect mathematics topics within the discipline and with other disciplines.

- **Number Sense and Numeration**
  Students will demonstrate their ability to apply estimation strategies to determine reasonableness of answers and to apply estimation in problem solving. Students will demonstrate their ability to solve problems using arithmetic operations which may include fractions and decimals.

- **Geometry and Spatial Sense**
  Students will demonstrate their ability to apply geometric relationships using area and apply this understanding to the concepts of probability.

- **Measurement**
  Students will demonstrate the ability to apply concepts of measurements using standard units of metric and U.S. customary units and apply these measurements to real-world problem solving situations.

- **Statistics and Probability**
  Students will demonstrate their ability to collect, organize and display data and will interpret data obtained from displays. Additionally, students will demonstrate the basic concepts of probability, including making predictions and finding possible outcomes. They will write reports based on their predictions and data displays.

- **Fractions and Decimals**
  Students will demonstrate their ability to solve problems, including determining possible outcomes, using fractions and decimals.

- **Patterns and Relationships**
  Students will demonstrate their ability to use basic algebraic reasoning to determine the relationship between real-world data and changes over time.

Grade/Level:

Grades 3-5

Duration/Length:

5 class days

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Collecting, organizing, and displaying data
- Frequency tables
- Graphing: bar graphs, line plots, line graphs
- Fractions
- Percentages
- Estimation
- Probability
- Measurement, in centimeters

Objectives:

Students will:

- work cooperatively in groups.
- collect, organize, and display data.
- identify possible solutions for a real life problem.
- record and analyze data.
- communicate mathematical data through writing.
- construct bar graphs, line plots, and line graphs.

- make predictions based on data displays

Materials/Resources:

- Latex balloons (assorted colors, about 50 per class)
- Mylar balloons (about 12 per class, but fewer will suffice if cost too high)
- Curling ribbon (one roll)
- Masking tape
- Chart paper
- Bulletin board paper
- Gram stackers (weights)
- Graph paper
- Paper bags (lunch size)
- Student resource sheets ("Balloon Journal", masters attached)
- Teacher resource sheets (masters attached)
- Clear jar
- Book (optional): *Balloon Magic* by Phyllis Adams (1987, Curriculum Press)

Development/Procedures:

Suggested Schedule

This unit contains three strands of activities: "Honey I Shrunk the Balloons", "Balloons in a Bag", and "Balloon Parachute Jump". A suggested schedule is shown below:

Day 1:

Literature Extension (optional): Read
Start "Honey I Shrunk the Balloons"

Day 2:

Estimation activity
"Honey I Shrunk the Balloons" - measurement
"Balloons in a Bag"

Day 3:

"Honey I Shrunk the Balloons" - measurement
"Balloon Parachute Jump"

Day 4:

"Honey I Shrunk the Balloons" - measurement
Extension Activities

Day 5:

Estimation - finish
"Honey I Shrunk the Balloons" - conclusion

Introduction

When introducing this unit you may want to read the book, *Balloon Magic*, written by Phyllis Adams. In this story Dad and sister Missy teach a boy named Tommy and his friends about balloons and the properties of air. This book allows students to begin thinking critically about what happens to balloons over a given period.

Estimation Activity

Teacher will prepare a jar of balloons in assorted colors and shapes; the students will make an estimation as to how many balloons they think are in the jar. The students will record estimations in their journals. At the end of the unit, the teacher and students should count the number of balloons in the estimation jar and compare the actual results to their predictions. (Student Resources, page 2)

Honey, I've Shrunk the Balloons!

This activity will take two whole class periods plus fifteen minutes a day on three additional days to complete. It will be best, in terms of recording data, to start this activity on a Monday and finish on a Friday. Otherwise, the balloons would likely shrink too much during an intervening weekend.

Day 1:

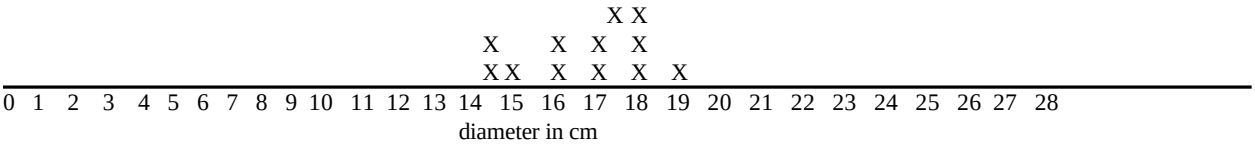
Divide the class into groups. Have each group blow up two or three latex balloons and attach a length of ribbon about four feet long to each balloon. You may want each group to label their balloons with masking tape looped around the ribbon.

Distribute mylar balloons (already inflated) among groups; again, you may wish to have groups label the balloons.

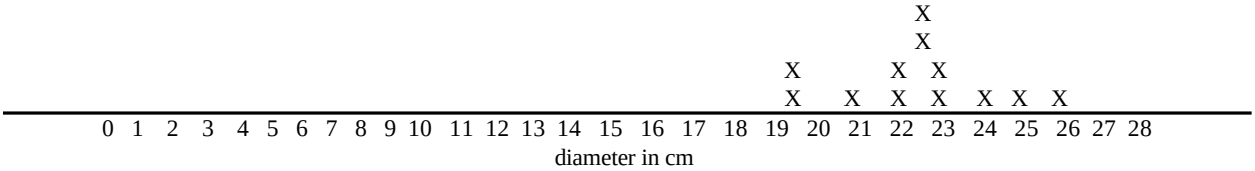
Have students measure the diameter across each balloon at its widest point. Using butcher paper, chalkboard, or overhead projector, have the students record the class results for all of the balloons on a **line plot** (see the sample below).

At the same time, students should be completing their own individual copies of the whole class data (see Student Resources, pages 3- 8). Ask students what the data show about the average size of balloons. (Students might use the mean, median or mode, or they might make "off the top of the head" observations.)

Diameter of Latex Balloons, Day One



Diameter of Mylar Balloons, Day One

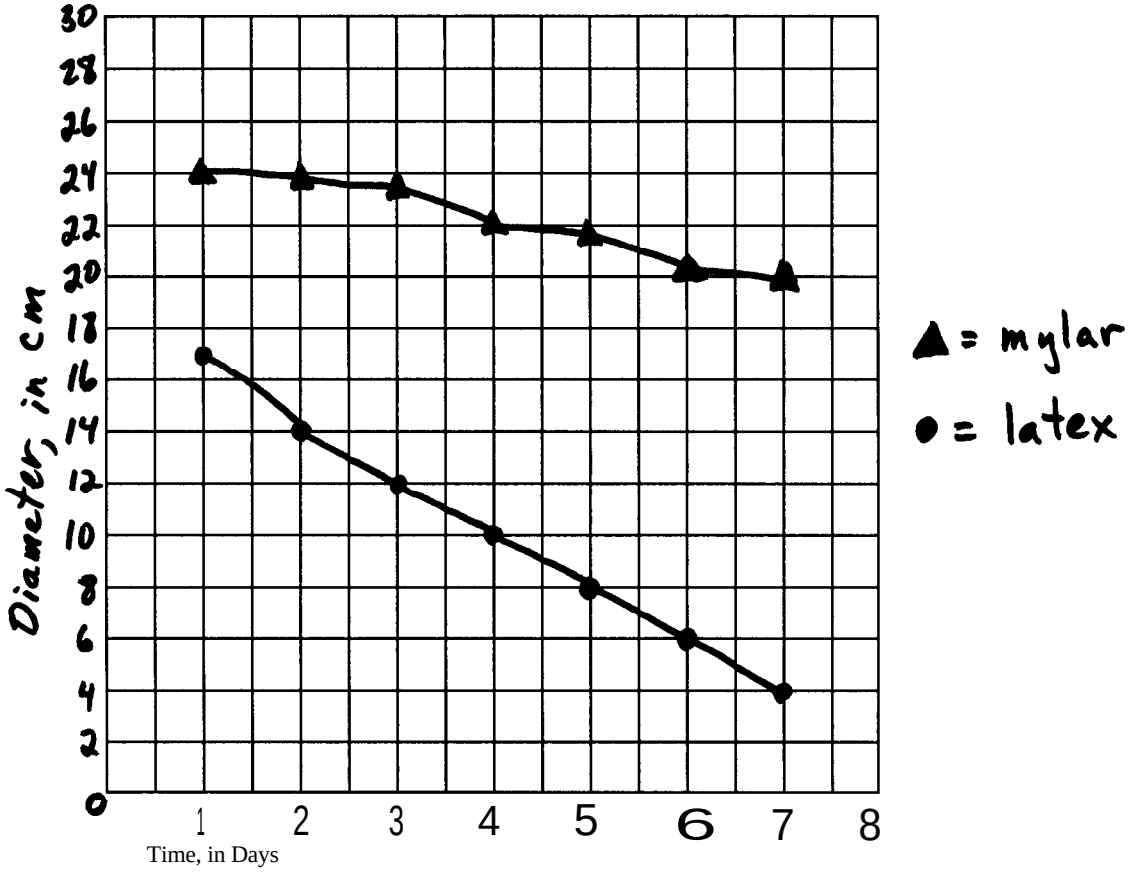


Ask the students to use the line plot to calculate the **median** diameter of the balloons on day one. (In the sample data, the median diameter of latex balloons is 17-cm and the median diameter of the mylar balloons is 24-cm). Ask the students how they could find the average diameter of each type of balloon. For this activity, the median probably would be the best measure of central tendency since any balloons which pop during the week probably would not significantly skew the data (in this particular case they could be ignored but students should be reminded that in most cases it is not appropriate to ignore data). The students will later use this data to construct a **line graph** showing the change in size over time.

Ask students to predict what will happen to the size of the balloons over time. They should record their predictions, along with reasons to support their predictions (Student Resources, page 4).

Using chart paper, chalkboard, overhead projector, or other large display, create a line graph for recording the size of the balloon as a function of time, with day going along the x-axis, and median diameter on the y-axis. To record size, use the median value calculated from the line plots. You may want to have students round this value to the nearest centimeter. Before setting up the graph, you may want to ask the students to choose the appropriate kind of graph for showing a change over time, and you may want to ask them what scale to use along each axis. The data for both the latex and mylar balloons will be recorded on the same graph, so you will need a key to distinguish between the two. As you or a student complete the line graph students should also complete their own personal copies in their balloon journals (Student Resources, page 4). A sample is shown on the next page.

Median Diameter of Latex &Mylar Balloons



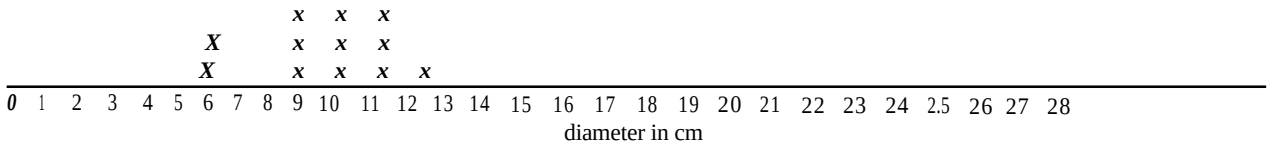
Davs Two - Four

Continue measuring diameter of balloons, constructing line plots, finding medians, and plotting new points on the line graph.

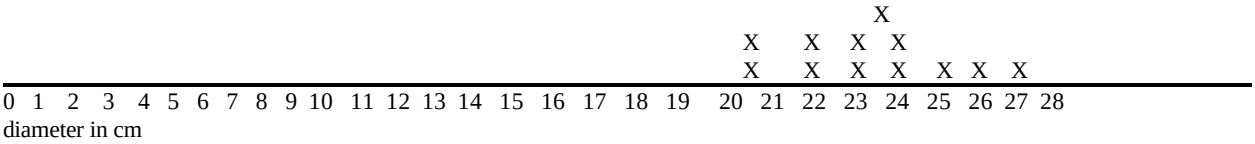
Dav Five

Measure diameter of the balloons, record on line plot, find the medians, and plot their points on the line graph. Sample data is shown below.

Diameter of Latex Balloons, Day Five



Diameter of Mylar Balloons, Day Five



Discuss the results of the line graph with the class, specifically the steepness of the lines. Suggested questions:

- What does this data show?
- How did the mylar balloons change over time?
- How did the latex balloons change over time?
- What would happen to the graph if we changed the scale?

The latex balloons should shrink faster than the mylar balloons, so the line for the latex balloons should "go downhill" faster.

Performance Assessment:

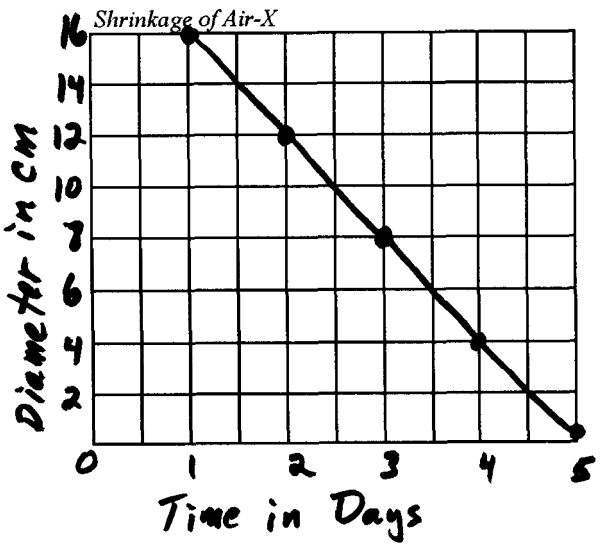
Because this unit was written for grades 3-5, you probably will not want to do every assessment activity. Choose the ones most appropriate for your students. See Balloon Journal (Student Resources, pages 9-14) for student copies.

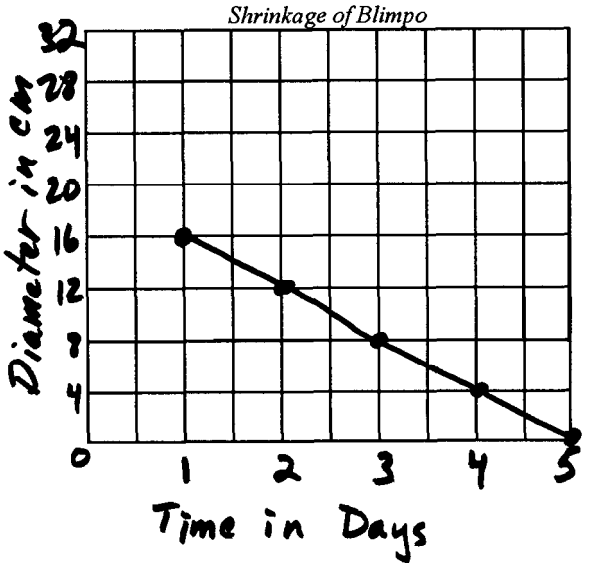
1. Journal Prompt

Your class is planning a 2-day math and science fair. The school is giving your class money to decorate the cafeteria for this fair. At the party store, latex balloons cost $7.00 per dozen. Mylar balloons cost $14.00 per dozen. The class would like to by 30 balloons so each student can take home a balloon. Which kind of balloon would you choose? Use the data shown in your line plots and line graph to support your answer.

2. Hot Air Labs

Hot Air Labs is designing two new types of balloons, the Blimpo and the Air-X Their research director Hal Ium says that Air-X is no good because they shrink much faster than the Blimpo. Do you agree with Hal? Use the data shown in the graphs below to support your answer.



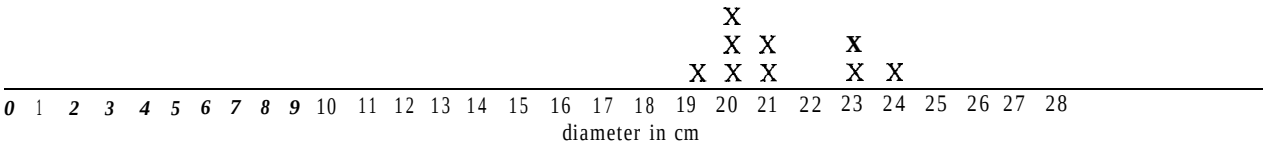


3. Ima Mess

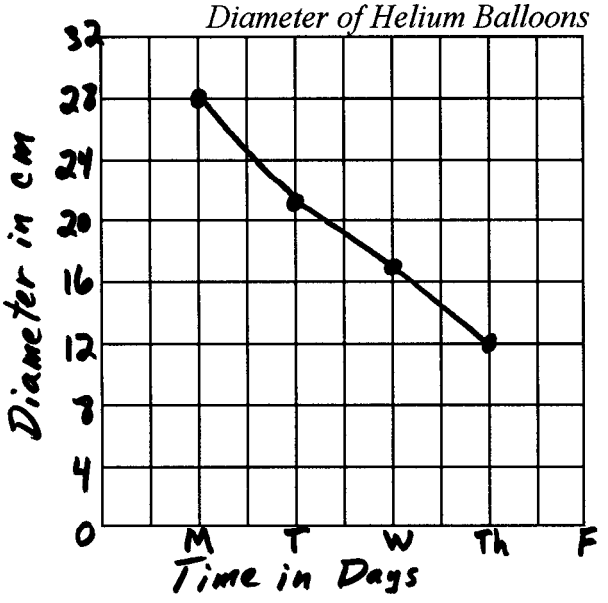
Ima Mess is hopeless disorganized. Her class is trying to track the change in size of helium-filled balloons over time .She is missing some data from her line plot for Tuesday, she forgot to record the median for Wednesday in her journal, and she lost all of her data for Friday . Can you help Ima figure out her missing data? Be sure to let her know how you figured out the missing numbers!

Tuesday: Given the data below, can you help Ima determine the missing data point? She did remember to write down that the median diameter for day one is 21 cm. Explain your answer.

Diameter of Helium Balloons, Tuesday



Wednesday: Ima can't find her line plot but she really wants to know what the median diameter for the helium-balloons was on Wednesday. Can you help her out? Don't forget to tell her how you got your answer.



Using the same line graph from the previous question, can you predict what the median diameter for the helium balloons would be on Friday? As always, Ima would appreciate your explaining your answer to her.

4. **Sir Speedy**

Sir Speedy is about to embark on a cross-country hot air balloon ride. He believes that he can travel 25 miles per day in his balloon. He would like to put this data on a line graph for quick reference while in flight (he can't fly and read at the same time). Make a graph for Sir Speedy for one week. Don't forget to include all the required elements of a line graph - Sir Speedy is very particular!

Balloons in a Bag

- Teacher will review information about balloons from previous day (**Day 1**). Teacher will explain to students that today they will be engaged in a probability lesson using balloons.
- Teacher will break the class into cooperative groups of 3 or 4 and distribute(refer to Student Resources, page 15) **,** graph paper, and paper bags with 10 balloons; 4 blue, 3 green, 2 red, and 1 yellow.
- Teacher will review the definition of **probability**; he/she will remind the students that probability is the chance that something will or will not happen.
- Teacher will explain that each group will pick from the paper bag 25 times.
- Have students predict how many balloons of each color they will pick from the paper bag; these predictions will be recorded on a frequency chart; after making predictions the students will pick from the paper bag 25 times and record this information on their **(**Student Resources, page **)**
- Students will graph their outcomes on 1-inch graph paper (1 sheet of graph paper per group). Graphs may be displayed on the chalkboard or bulletin board paper. Teacher will facilitate a class discussion about the outcomes of each graph.

Assessment

This assessment will be teacher-directed. The teacher will orally read the following statements:
When making your picks from the paper bags the following will happen:

1. The balloon will be blue.
2. You will not pick a green balloon.
3. The balloon will be white.
4. At least one balloon will be white.
5. At least 20 balloon picks will be red.

Students will respond to the above statements on a **Probability Scale.** The students will place the number of the statement on the probability scale. (See Resource #)

Balloon Parachute Jump

Discuss the nature of balloons with students. Helium-filled balloons can stay up in the air for a while, but balloons without helium will float for a while and then drop to the ground. Let the student's know that students are going to do an activity investigating the way air-filled balloons drop.

Divide the class into four groups. Give each group a balloon with a 20-gram stacker weight attached to the end of it. Each group will be given a target constructed by the teacher (Teacher Resources, page 4).

The students must stand at the outer edge of the target and let their balloons parachute down to land on the target. The target should be color-coded and labeled with numbers. Each group will have 25 chances to try to get their balloons to parachute to the center of the target's bulls eye.

Before students begin, have them complete the following chart in their balloon journals (Students will copy the following chart in their journal.)

What are the possibilities of your balloon landing on the following target areas:

Target	**Prediction**	**Tally**	**Frequency**	**Relative Frequency**	**Percentage of Drops**
Red (50 pts)					
Yellow (25 pts)					
Orange (15 points)					
Green (10 points)					
Totals:	25	𝍸 𝍸 𝍸 𝍸 𝍸	---------	25/25	100%

At the conclusion of the activity, the teacher should use chart paper, chalkboard, overhead, or other large display, for all groups to record the data for a whole-class set of data.

Students should discuss how their predictions compared to their actual findings. The teacher may want to compare the theoretical probability with the experimental probability (Teacher Resources, page 4). Discuss why the results were similar or different.

Extensions

1. Using the information from the frequency chart, student can create bar graphs showing how many times a balloon landed on a certain color. Students should take care to include a title, and labels and scales for both axes .

2. The teacher can change the target so that it might be, for example ½ red, 1/4 blue, and 1/4 yellow, asking students to predict how often the balloons would land on a certain color.

Extension/Follow Up

1. Balloons in science (weather and atmospheric investigations)
2. Properties of gases (pressure and volume investigations)
3. Balloons as transportation (precursor to airplanes)

Authors:

Deborah McNeal
Southwestern Elementary
Chesapeake, Virginia

Veronica Pulley
Western Branch Int.
Chesapeake, Virginia

Kathleen Van Dyke
Langston Hughes Middle School
Fairfax, Virginia

Honey, I Shrunk the Balloons

Answer Key and Grading Rubrics

Journal Prompt

Assess according to attached rubric.

Hot -Air Labs

Both sets of balloons shrink at approximately the same rate. The different scales accounts for the difference in slope.

Ima Mess

a. Since the median is 21 there should be an equal number of points less than 21 and greater than 21. Since there are four data points less than 21 and three data points greater than 21, the missing data point must be greater than 21 but without further information, we cannot determine its exact value.

b. Since the line graph plots the median diameter in centimeters by day, to find the median value, move along the x-axis to Wednesday and find the corresponding value on the y-axis. In this case, the value is 17.

c. Extend the line to Friday and we find that the value would be ____.

Sir Speedy

Assess according to graphing rubric.

Rubric for Graphs

4 Points

- Graphs are clear.
- Graphs contain the following components:
  - -labels
  - -scales
  - -key (where applicable)
- All graphs are neat and easy to read.
- Data points are plotted accurately.

3 Points

- Graphs are clear.
- Most graphs contain the following components:
  - -labels
  - -scales
  - -key (where applicable)
- Most graphs are neat and easy to read.
- Data points are plotted accurately.

2 Points

- Most graphs are clear.
- Some graphs are missing the following components:
  - -labels
  - -scales
  - -key (where applicable)
- Some graphs are neat and easy to read.
- Several points are plotted inaccurately.

1 Point

- Graphs are unclear.
- Many graphs are missing the following components: labels, scales, key (where applicable)
- Graphs may or may not be neat and easy to read.
- Many points are plotted inaccurately.

0 Points

- No reasonable attempt made.

Balloons Comparison Rubric

4 Points

- Student referred to specific data from line graph.
- Student compared costs and durability of two types of balloons and conclusions show correct interpretation of line graph data.
- Written explanation is clear, easy to understand, and well organized.

3 Points

- Student referred to data, but not specific data points.
- Student compared costs and durability of two types of balloons and conclusions show correct interpretation of line graph data.
- Written explanation shows clear understanding of data from line graph, but may not be well organized.

2 Points

- Student referred to data, but not specific data points.
- Student compares and contrasts cost and durability of both types of balloons, but conclusion shows some confusion.
- Written explanation may or may not be well organized; understanding may not be clear.

1 Point

- Student does not refer to data.
- Student attempts to justify choice of data, but does not compare and contrast cost durability.
- Written explanation does not demonstrate understanding of the problem.

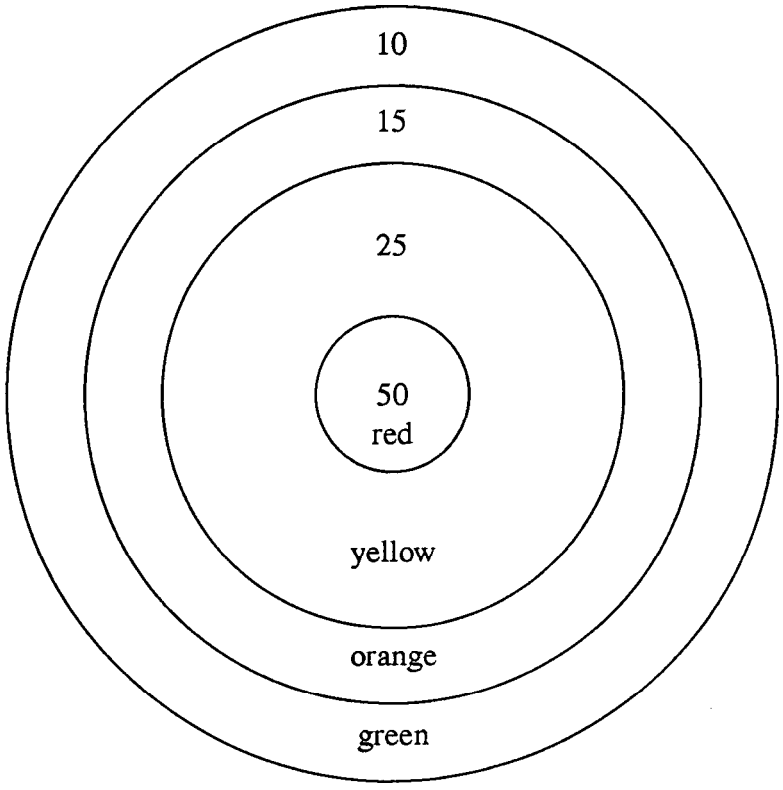
0 Points

- No reasonable response given.

BALLOON PARACHUTE JUMP

You want to have the students compare the relative frequency for the balloon parachutes landing on each color of the target with the actual area of the target. The area for each color is given for a the target constructed according to the dimensions below.

Circle	Diameter	Approximate Area of Ring	% of Total Area
Red	1 ft.	.8 sq. ft.	**4%**
Yellow	3 ft.	6.3 sq. ft.	32%
Orange	4 ft.	5.5 sq. ft.	28%
Green	5 ft.	7.0 sq. ft.	36%
TOTALS:	-------	19.6 sq. ft.	100%



Name:_____

Journal

Balloons, Balloons, Flying High!

Estimation Jar

How many balloons do you think are in the jar? Record your prediction on the chart below. Don't forget to use good estimation strategies!

Prediction	Actual Number	Difference

How did you make your prediction? What factors did you consider? What strategies did you use. Explain below.

How did the actual amount compare with your prediction? Were you surprised? Why or why not?

Honey, I've Shrunk the Balloons!

Create a line plot showing, in centimeters, the diameter of the Mylar balloons in your class. Be sure to show the scale!

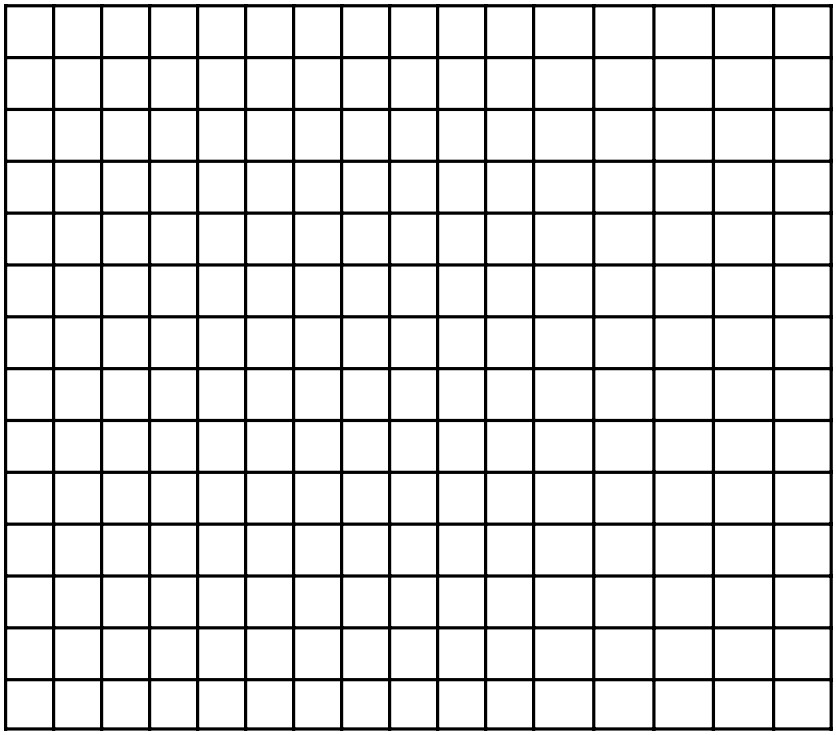
Diameter of Latex Balloons, Day One

Diameter of Mylar Balloons, Day One

How do you think the size of the balloons will change over time? Be sure to give reasons to support your response.

For each day plot the median diameter of the latex and Mylar balloons. After the last day, connect all the points for the latex balloons and then connect all the points for the Mylar balloons. Don't forget to label each axis, show the scale, and create a key to keep the data for the latex and Mylar balloons separate.

Median Diameter of Latex & Mylar Balloons



Diameter of Latex Balloons, Day Two

Diameter of Mylar Balloons, Day Two

Your Thoughts!

Diameter of Latex Balloons, Day Three

Diameter of Mylar Balloons, Day Three

Your Thoughts!

Diameter of Latex Balloons, Day Four

Diameter of Mylar Balloons, Day Four

Your
Thoughts!

Diameter of Latex Balloons, Day Five

Diameter of Mylar Balloons, Day Five

Your
Thoughts!

Your class is planning a 2-day math and science fair. The school is giving your class money to decorate the cafeteria for this fair. At the party store, latex balloons cost $7.00 per dozen. Mylar balloons cost $14.00 per dozen. The class would like to by 30 balloons so each student can take home a balloon. Which kind of balloon would you choose? Use the data shown in your line plots and line graph to support your answer.

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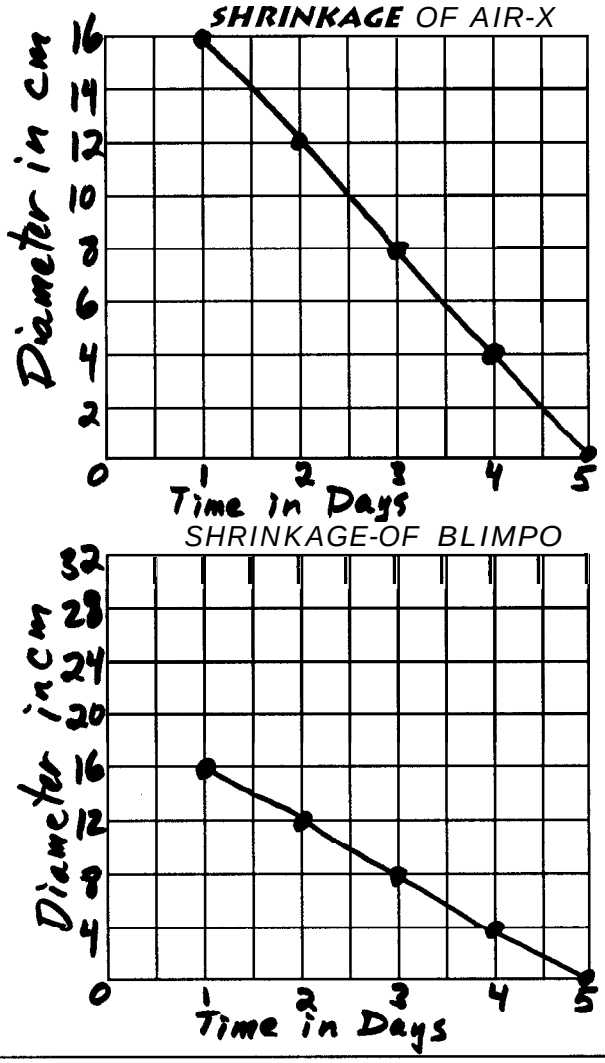

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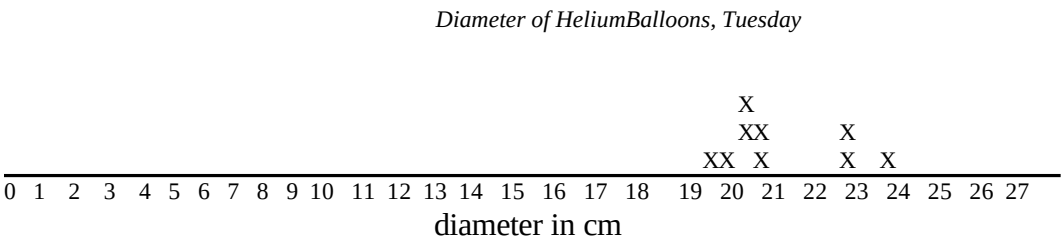
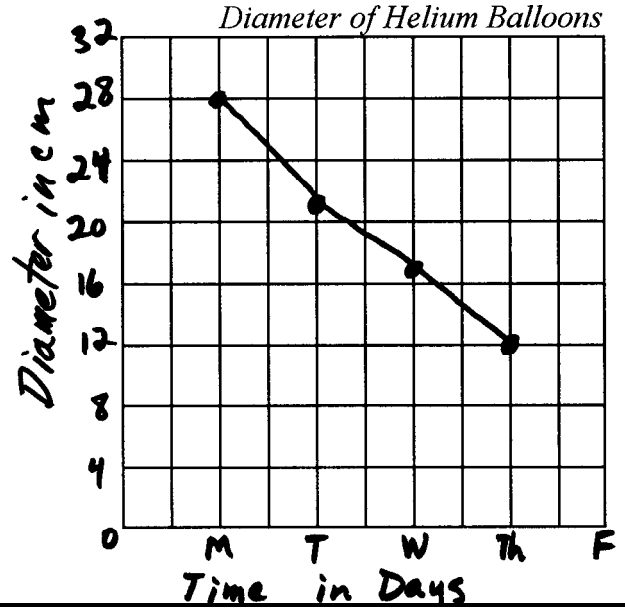
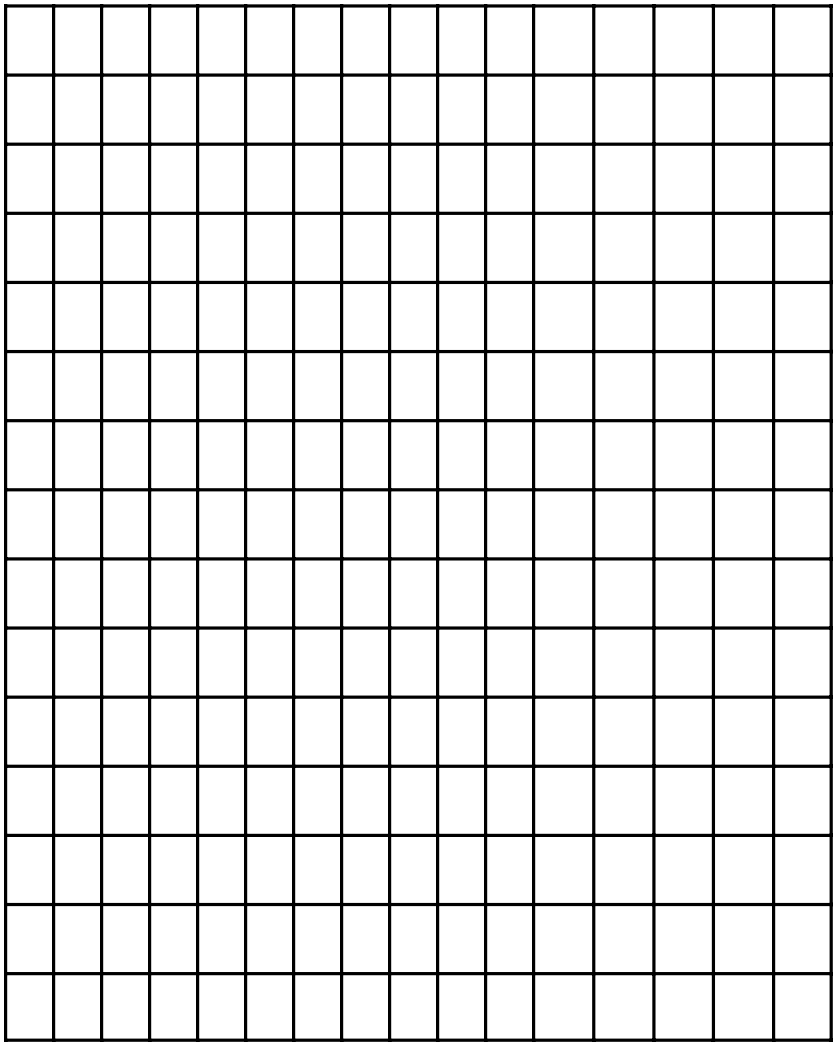


b. Wednesday: Ima can't find her line plot but she really wants to know what the median diameter for the helium-balloons was on Wednesday. Can you help her out? Don't forget to tell her how you got your answer.



c. Using the same line graph from the previous question, can you predict what the median diameter for the helium balloons would be on Friday? As always, Ima would appreciate your explaining your answer to her.

Sir Speedy is about to embark on a cross-country hot air balloon ride. He believes that he can travel 25 miles per day in his balloon. He would like to put this data on a line graph for quick reference while in flight (he can't fly and read at the same time). Make a graph for Sir Speedy for one week.



Balloons in a Bag

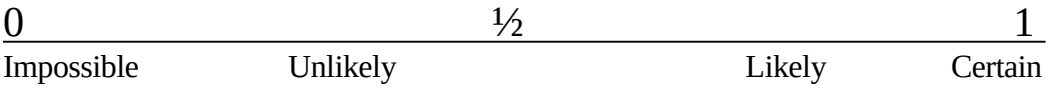
Frequency Chart

Color	Prediction	Frequency (Use Tally)
Blue		
Green		
Red		
Yellow		

Balloons in a Bag

1. The balloon will be blue.
2. You will not pick a green balloon.
3. The balloon will be white.
4. At least one balloon will be white.
5. At least 20 balloon picks will be red.

Probability Scale



Balloon Parachute Jump

Target	Prediction	Tally	Frequency	Relative Frequency	Percentage of Drops
Red (50 pts)					
Yellow (25 pts)					
Orange (15 points)					
Green (10 points)					
Totals:	25	𝍸 𝍸 𝍸 𝍸 𝍸	---------	25/25	100%

How did you make your prediction? What factors did you consider? What strategies did you use. Explain below.

How did the actual amount compare with your prediction? Were you surprised? Why or why not?